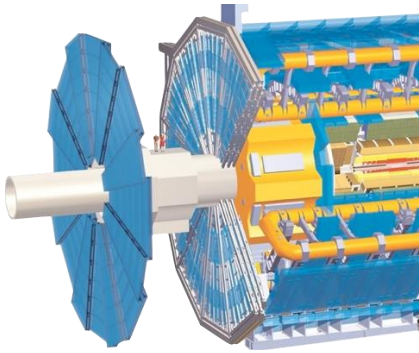
TEXAS
The University of Texas at Austin

ATLAS EXPERIMENT



UT-Austin ADC Design ATLAS LAr Calorimeter at HL-LHC

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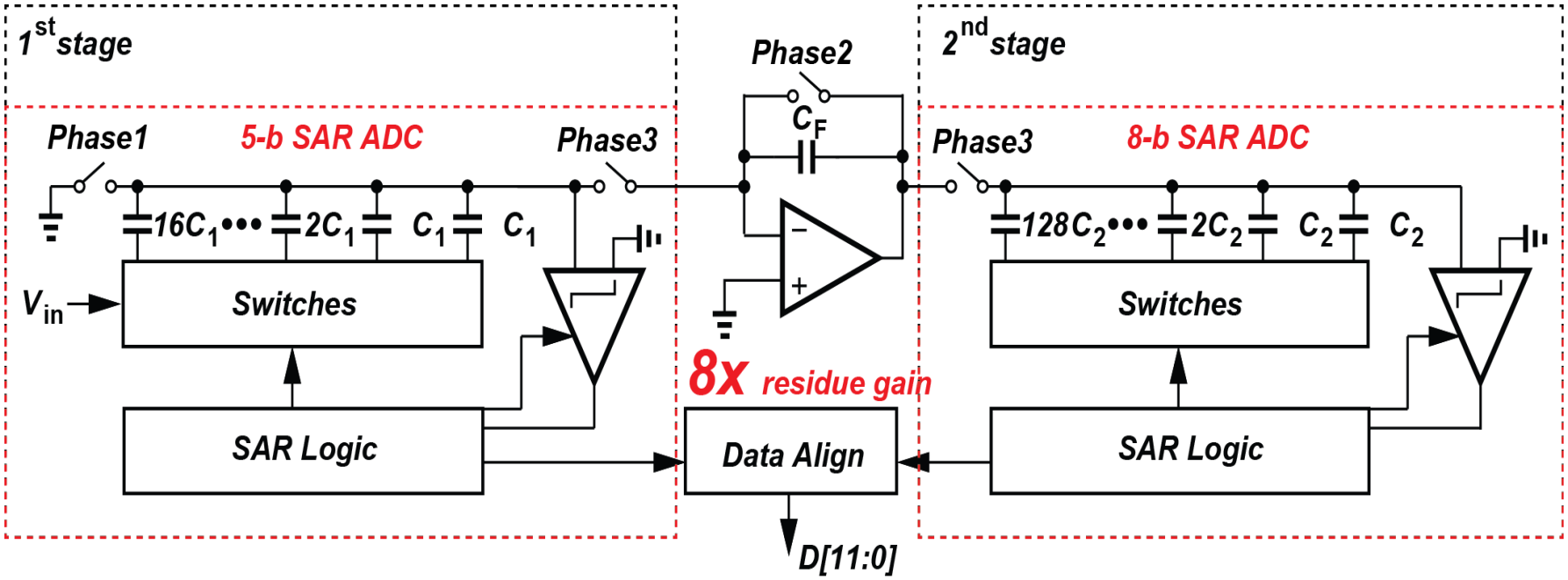
Nov 4, 2016

What about 8x inter-stage gain ?

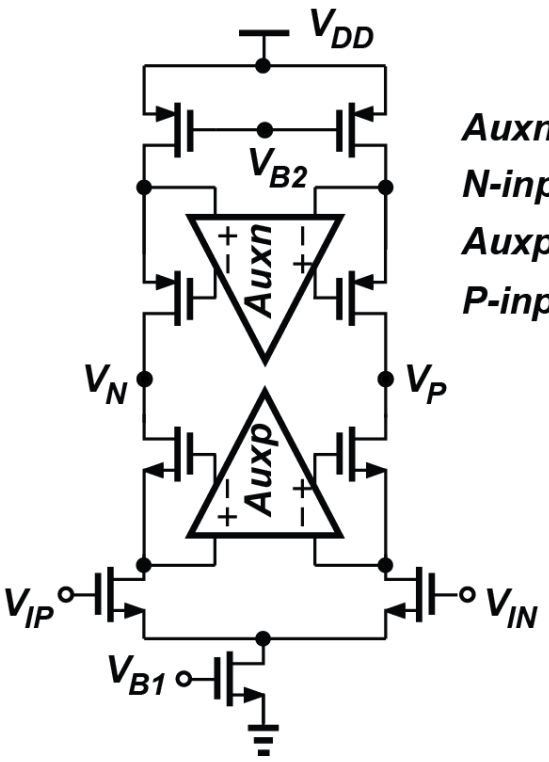


Open-Loop Gain can be reduced from 78dB to 72dB.

Unit-Gain Bandwidth can be reduced from 1.27GHz to 635MHz.

Due to reduced swing, maybe we can just use telescopic with gain boosting(One-stage which means low power).

OPAMP

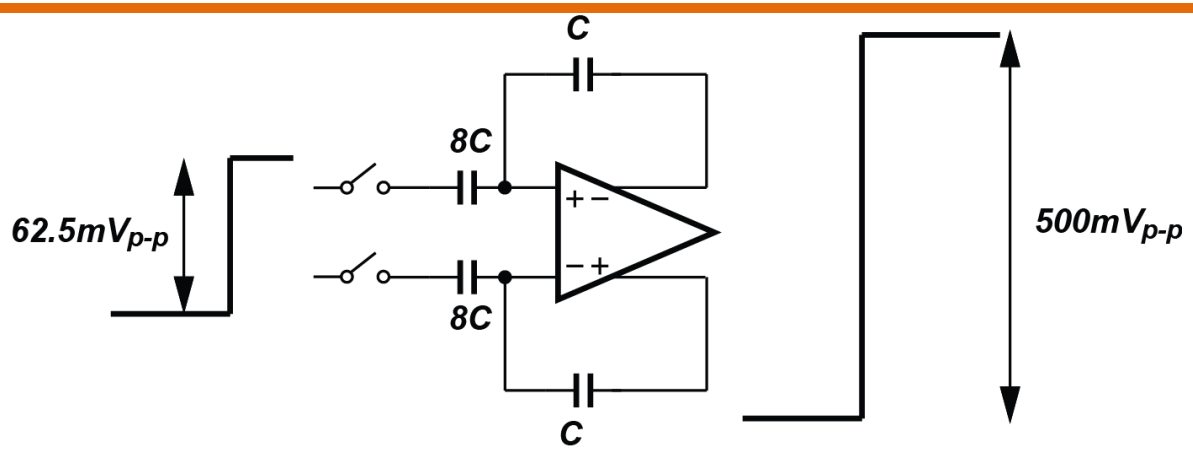


Auxn:
N-input Folded Cascode
Auxp:
P-input Folded Cascode

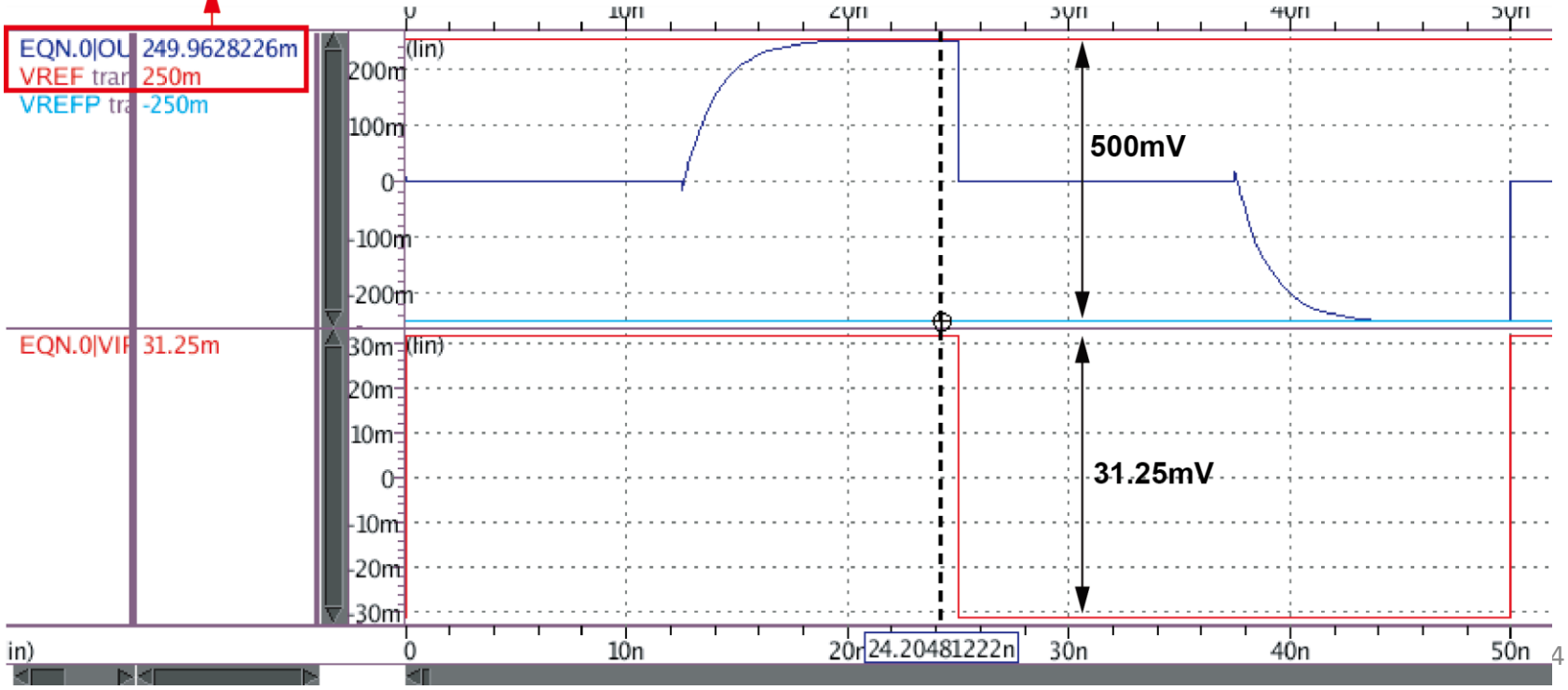
	Specification
Supply Voltage	1.2 V
Technology	TSMC 65LP 1P6M
DC Gain	80dB
Current-Main	750uA
Current-Auxn	100uA
Current-Auxp	100uA
Bias Circuit	200uA
PhaseMargin	80 degree
Unit-Gain Freq	2.1GHz

- According to [1], the frequency response of this opamp has to be carefully designed to ensure stability and to avoid pole-zero doublet, causing slow settling.
- $\beta\omega_{main,ta} < \omega_{aux,ta} < \omega_{main,2n\,pole}$

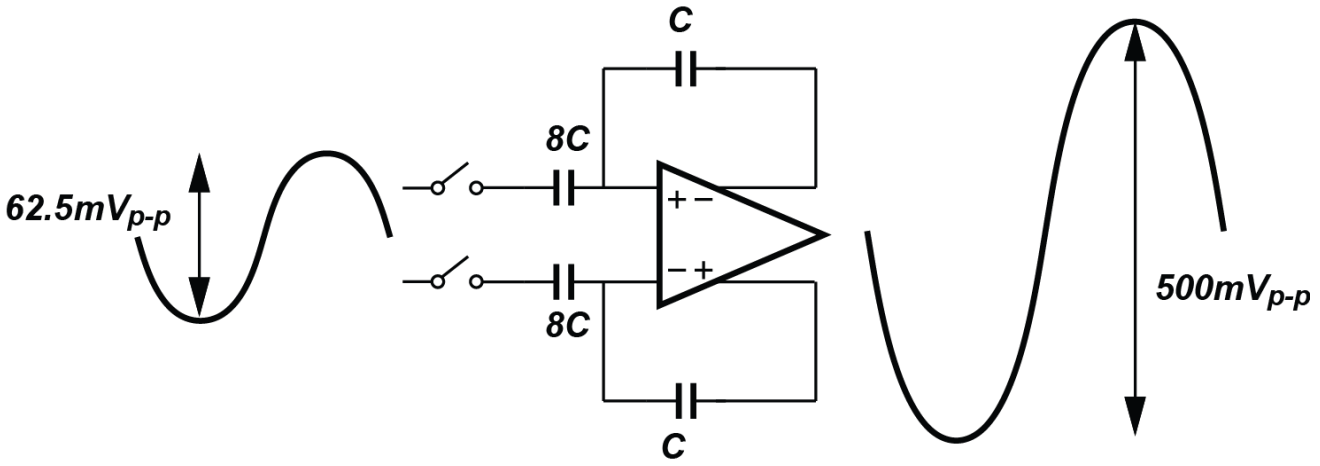
Step Response

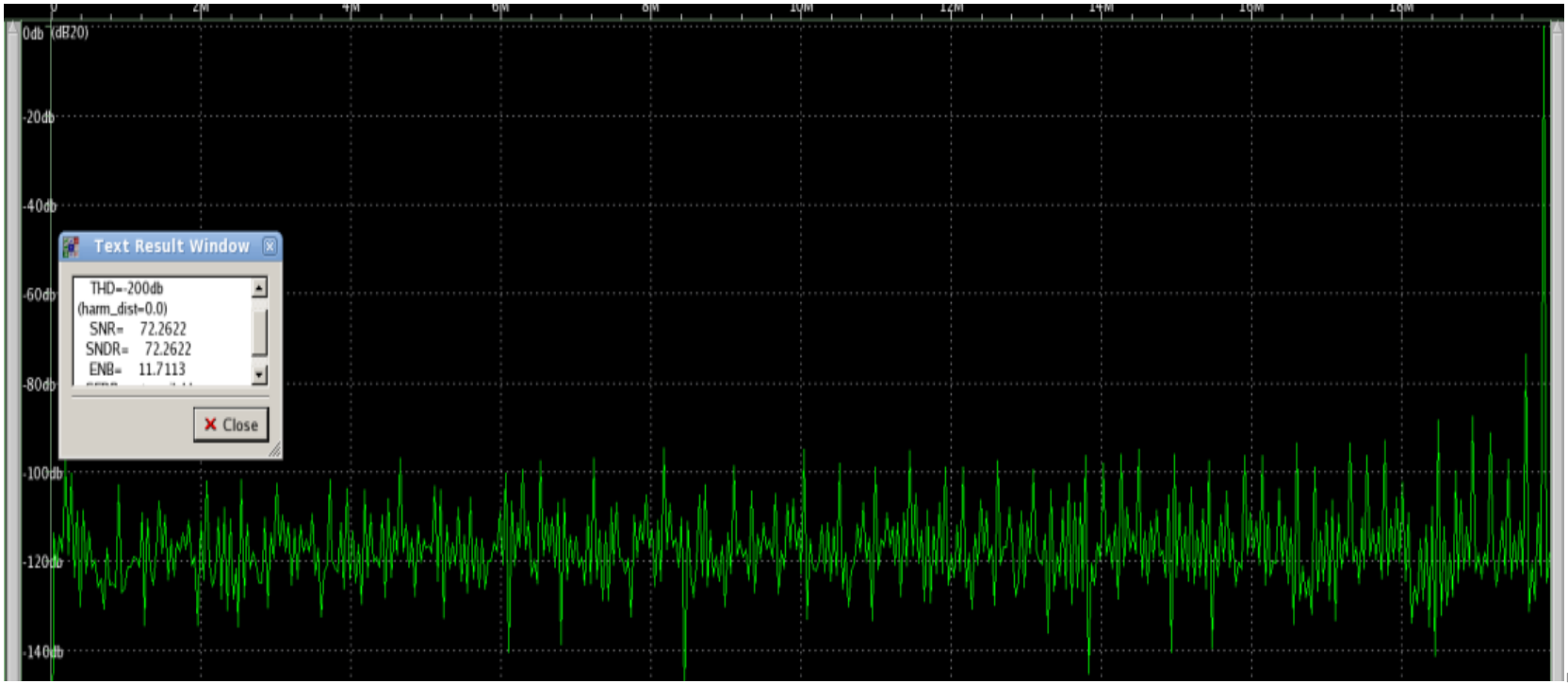


Error = 250m-249.96m = 0.04m < (0.5)/2^9



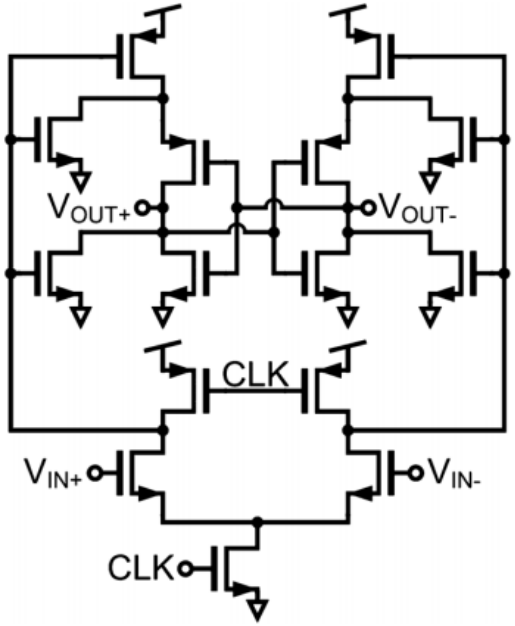
Linearity Test



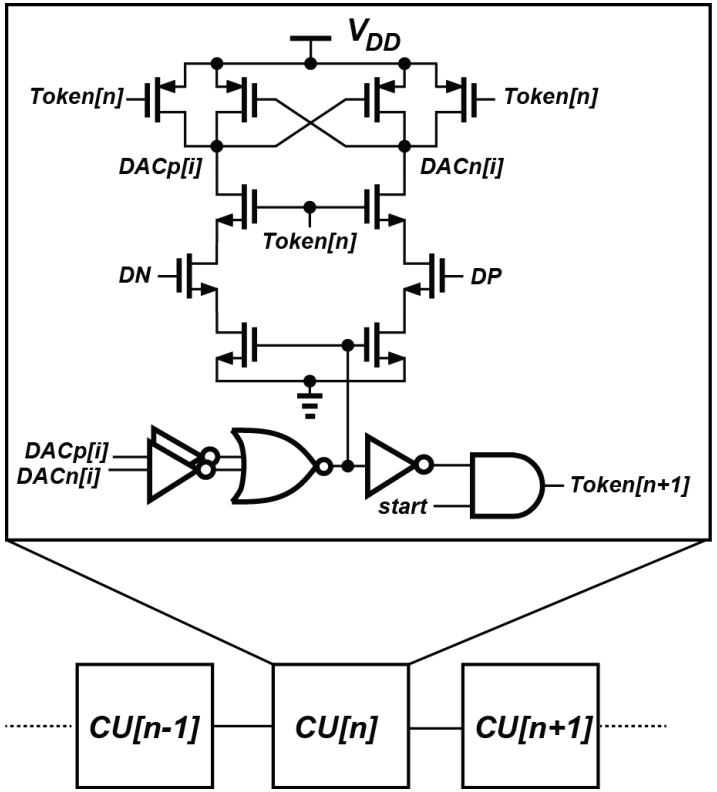


Comparator & SAR Logic

- [2] ISSCC' 15
- Low noise single phase dynamic latched comparator

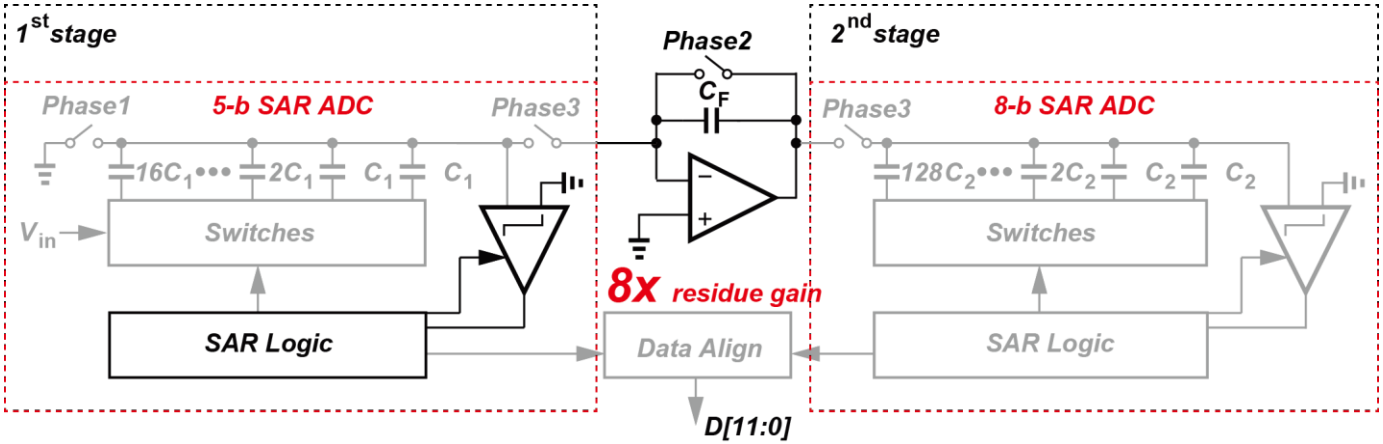


- [3] VLSI'11
- Direct switching

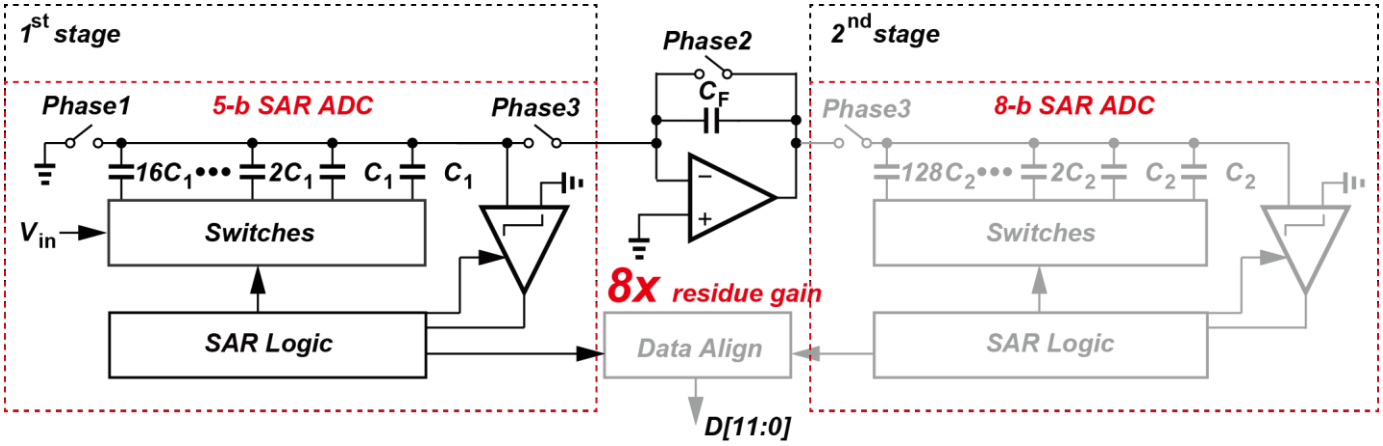


Progress

- **Things have been done:**



- **Future Plan(in the near 1 to 2 weeks):**



Some 12-b Prior Arts

	[4] ESSCIRC'16	[2] ISSCC'15
Architecture	Noise Shaping SAR ADC	Pipeline SAR ADC
Technology	130 nm	65 nm
DAC Calibration	No	No
Total capacitance	2.1 pF	2.048 pF
SNDR	74 dB	70.9 dB
SFDR	95 dB	84.6 dB

Reference

1. K. Bult and G. J. G. M. Geelen, “A fast-settling CMOS Op Amp for SC circuits with 90-dB dc gain,” ***IEEE J. Solid-State Circuits***, vol. 25, pp.1379–1384, Dec. 1990.
2. Y. Lim and M. P. Flynn, “A 1 mW 71.5 dB SNDR 50 MS/S 13b fully differential ring-amplifier-based SAR-assisted pipeline ADC,” ***in Proc. IEEE ISSCC. Dig. Tech. Papers***, Feb. 2015, pp. 1–3.
3. J.-H. Tsai, Y.-J. Chen, M.-H. Shen and P.-C. Huang, “A 1-V, 8b, 40MS/s, 113µW Charge-Recycling SAR ADC with a 14µW Asynchronous Controller,” ***Symp. on VLSI Circuits***, pp. 264-265, June 2011.
4. Wenjuan Guo, and Nan Sun , “A 12b-ENOB 61µW noise-shaping SAR ADC with a passive integrator ,” ***ESSCIRC,*** pp. 405-408, Oct. 2016.